

In re Patent Application of:  
**MACCHETTI ET AL.**  
Serial No. 09/974,705  
Filed: October 10, 2001

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21. A method of converting data between an unencrypted format and an encrypted format, the data being organized in bit words, the method comprising:

performing a plurality of transformation rounds, each transformation round comprising

applying at least one transformation to a two-dimensional array of rows and columns of bit words defining a state array; and

transposing rows and columns of the state array to form a transposed state array for at least one of the transformation rounds so that the at least one transformation is applied to the transposed state array.

22. A method according to Claim 21 wherein the bit words are 8-bit words.

23. A method according to Claim 21 wherein the state array is a 4 x 4 matrix of bit words.

24. A method according to Claim 21 wherein the plurality of transformation rounds comprises at least 10 transformation rounds.

25. A method according to Claim 21 wherein performing comprises performing at least one transformation round once a non-transposed state array in at least one of the plurality of transformation rounds.

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26. A method according to Claim 21 further comprising applying at least one round key to the state array in at least one of the transformation rounds.

27. A method according to Claim 26 wherein the at least one round key is transposed before being applied to the state array.

28. A method according to Claim 26 further comprising adding code to transpose the at least one round key.

29. A method according to Claim 26 wherein the at least one round key comprises a plurality of round keys, each corresponding to a respective transformation round and being applied according to a round key schedule.

30. A method according to Claim 29 wherein the round key schedule comprises a transposed round key schedule.

31. A device for converting data between an unencrypted format and an encrypted format, the device comprising:

at least one register for storing the data in the form of bit words; and

a circuit for

performing a plurality of transformation rounds, each transformation round comprising applying at least one transformation to a two-

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dimensional array of rows and columns of bit words  
defining a state array, and

transposing rows and columns of the state array  
to form a transposed state array for at least one of  
the transformation rounds so that at least one  
transformation is applied to the transposed state  
array.

32. A device according to Claim 31 wherein said at  
least one register stores bit words as 8-bit words.

33. A device according to Claim 31 wherein said  
circuit operates on a state array comprising a 4x4 matrix of  
bit words.

34. A device according to Claim 31 said circuit in  
performing a plurality of transformation rounds performs at  
least 10 transformation rounds.

35. A device according to Claim 31 wherein said  
circuit comprises at least one S-box processing module, said  
at least one S-box processing module operating on a group of  
bit words defining a cell of a column of the state array.

36. A device according to Claim 35 wherein the at  
least one S-box processing module comprises a plurality of S-  
box modules, each of the plurality of S-box modules operating  
on a corresponding cell of a column of the state array.

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37. A device according to Claim 36 wherein the column of the state array comprises four cells.

38. A device according to Claim 31 wherein the circuit further comprises a plurality of shift column modules, each of said plurality of shift column modules to perform a column shift operation on a column of the state array.

39. A device according to Claim 38 wherein a column shift operation performed by each of said plurality of shift column modules generates shift column data, and wherein said circuit further comprises a single mix column module to perform column mix operations on shift column data.

40. A device according to Claim 31 wherein said circuit is an encoder for converting data from an unencrypted data format to an encrypted data format.

41. A device according to Claim 40 wherein said circuit is an embedded system for use in a smart card.

42. A device according to Claim 31 wherein said circuit is a decoder for converting data from an encrypted data format to an unencrypted data format.

43. A device according to Claim 42 wherein said circuit is an embedded system for use in a smart card.

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44. A device for converting data between an unencrypted format and an encrypted format, the device comprising:

at least one register for storing the data in the form of bit words; and

a circuit for

performing a plurality of transformation rounds, each transformation round comprising applying at least one transformation to a two-dimensional array of rows and columns of bit words defining a state array,

transposing rows and columns of the state array to form a transposed state array for at least one of the transformation rounds so that at least one transformation is applied to the transposed state array, and

applying at least one round key to the state array in at least one of the transformation rounds.

45. A device according to Claim 44 wherein said circuit comprises a plurality of S-box modules, each of the plurality of S-box modules operating on a respective group of bit words, each group defining a cell of a column of the state array.

46. A device according to Claim 45 wherein the circuit further comprises a plurality of shift column modules, each of said plurality of shift column modules to perform a column shift operation on a column of the state array.